Humans and automata: A social study of robotics

Book · August 2015

DOI: 10.3726/978-3-653-05946-5

CITATIONS
24

READS
950

1 author:

Riccardo Campa
Jagiellonian University
168 PUBLICATIONS **621** CITATIONS

SEE PROFILE

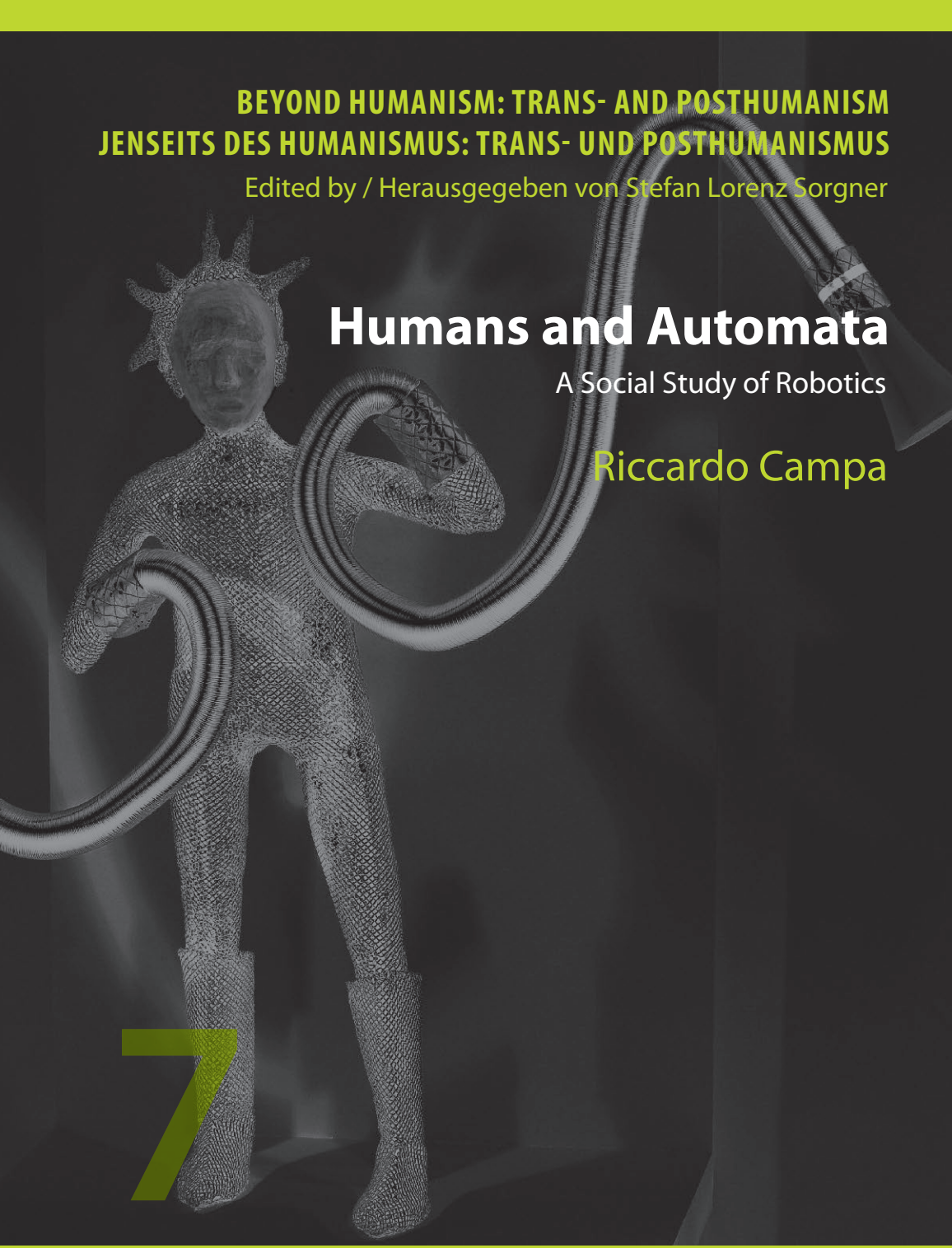
BEYOND HUMANISM: TRANS- AND POSTHUMANISM
JENSEITS DES HUMANISMUS: TRANS- UND POSTHUMANISMUS

Edited by / Herausgegeben von Stefan Lorenz Sorgner

Humans and Automata

A Social Study of Robotics

Riccardo Campa



7

PETER LANG
EDITION

The book takes a close look at the social dimensions of robotics. It examines some of the projects on which robotic engineers are presently working, explores the dreams and hopes connected with these undertakings and determines if there is a relation between automation and unemployment within the socio-economic system. Furthermore, it explores the possible futures generated by the development of artificial intelligence and outlines the core ideas of roboethics. Last not least, it examines the systems of military robots, with special emphasis on the ethical issues raised by the design, construction and utilization of these systems of weaponry.

Riccardo Campa is Professor Extraordinarius of Sociology of Science and Technology at the Jagiellonian University in Krakow, Poland, and Fellow of the Institute for Ethics and Emerging Technologies.

www.peterlang.com

ISBN 978-3-631-66628-9

Humans and Automata

BEYOND HUMANISM: TRANS- AND POSTHUMANISM
JENSEITS DES HUMANISMUS: TRANS- UND POST-HUMANISMUS

Edited by / Herausgegeben von Stefan Lorenz Sorgner

VOL./BD. 7

Zu Qualitätssicherung und Peer Review der vorliegenden Publikation

Die Qualität der in dieser Reihe erscheinenden Arbeiten wird vor der Publikation durch den Herausgeber der Reihe geprüft.

Notes on the quality assurance and peer review of this publication

Prior to publication, the quality of the work published in this series is reviewed by the editor of the series.

Riccardo Campa

Humans and Automata

A Social Study of Robotics

PETER LANG
EDITION

Bibliographic Information published by the Deutsche Nationalbibliothek
The Deutsche Nationalbibliothek lists this publication in the Deutsche Nationalbibliografie; detailed bibliographic data is available in the internet at http://dnb.d-nb.de.

Cover illustration:
Rita de Muynck: Is the Future in the Past? Cyborg.
Audio-sculptural Installation.
Sheet, ideas, text, eartrumpets, spreaker, sound.
145 x 250 x 65 cm, 2011.
(© De Muynck,
Foto: Susanne Hesping)

ISSN 2191-0391
ISBN 978-3-631-66628-9 (Print)
E-ISBN 978-3-653-05946-5 (E-Book)
DOI 10.3726/978-3-653-05946-5

Peter Lang – Frankfurt am Main · Bern · Bruxelles · New York · Oxford · Warszawa · Wien

This publication has been peer reviewed.

www.peterlang.com

BEYOND HUMANISM: TRANS- AND POSTHUMANISM
JENSEITS DES HUMANISMUS: TRANS- UND POSTHUMANISMUS

Edited by / Herausgegeben von Stefan Lorenz Sorgner

Vol./Bd.	1	Robert Ranisch / Stefan Lorenz Sorgner (eds.): Post- and Transhumanism. An Introduction. 2014.
Vol./Bd.	2	Stephen R. L. Clark: Philosophical Futures. 2011.
Vol./Bd.	3	Hava Tirosh-Samuelson / Kenneth L. Mossman (eds.): Building Better Humans? Refocusing the Debate on Transhumanism. 2012.
Vol./Bd.	4	Elizabeth Butterfield: Sartre and Posthumanist Humanism. 2012.
Vol./Bd.	5	Stefan Lorenz Sorgner / Branka-Rista Jovanovic (eds.). In cooperation with Nikola Grimm: Evolution and the Future. Anthropology, Ethics, Religion. 2013.
Vol./Bd.	6	Bogdana Koljević: Twenty-First Century Biopolitics. 2015.
Vol./Bd.	7	Riccardo Campa: Humans and Automata. A Social Study of Robotics. 2015.

www.peterlang.com

At bottom, robotics is about us. It is the discipline of emulating our lives, of wondering how we work.
Rod Grupen

Contents

Preface 11

Acknowledgments 21

1. Engineers and Automata 23
   1.1 A definition of 'robot' 23
   1.2 An historical overview 24
   1.3 The bottom-up approach to robotics 26
   1.4 The rise of social robots 29

2. Workers and Automata 37
   2.1 Artificial Intelligence and Industrial Automation 37
   2.2 Effects on the level of employment 40
   2.3 Social stratification and new generation robots 47
   2.4 The need for a new socio-industrial policy 49

3. Citizens and Automata 55
   3.1 Technology and unemployment 55
   3.2 Some methodological tools for scenario analysis 59
   3.3 The unplanned end of work scenario 62
   3.4 The planned end of robots scenario 64
   3.5 The unplanned end of robots scenario 67
   3.6 The planned end of work scenario 70
   3.7 An ethical judgement 74
   3.8 Conclusions 75

4. Roboethicists and Automata 77
4.1 Roboethics: a discipline in statu nascendi 77
4.2 A discipline concerned with futurabilia 80
4.3 Roboethical codes 84
4.3.1 Asimov's three laws of robotics 86
4.3.2 The Euron Codex 89
4.4 Evolution and legal responsibility 93
4.5 Possible ethical problems in android robotics 98
4.5.1 The NDR 114 Model 98
4.5.2 The Galatea Model 101
4.5.3 The Messalina Model 105
4.5.4 The Gurdulù Model 106
4.5.5 The Golem Model 107

5. Soldiers and Automata 109
5.1 Defining robotic weapon 109
5.2 Robots of the sky, the sea, and the land 110
5.2.1 Sky Robots 113
5.2.2 Sea Robots 116
5.2.3 Land Robots 116
5.3 The main functions of the military robots 121
5.4 Main objections to the belligerent use of robots 125
5.4.1 Noal Sharkey's plea 125
5.4.2 Robotic wars as war crimes without criminals? 127
5.4.3 Trivialization and multiplication of armed conflicts 127
5.5 Analyses and propositions 134
5.5.1 The Impracticability of the Moratorium 135
5.5.2 Pragmatism as a remedy for undesired effects 137
5.5.3 Voyeurism as an antidote to conflict escalation 139
5.5.4 Correct information as a counterweight to alarmism 140

5.5 Scenario analysis: dreams and nightmares 142
5.6 Conclusions 146

Bibliography 151

Index of names 161

Preface

This book, as its title should quite clearly comunicate, is not on robotics as such, but rather on the social dimensions of robotics. So, let us start from a question: given that the author of this book is a sociologist, why is the research named 'a social study,' and not 'a sociological study,' of robotics? The main reason is that I explore different aspects of robotics, more specifically, the historical, economic, ethical, political, and futurological ones. The adjective that could possibly include all these aspects is 'social.' If sociology were the superscience originally intended by its founders in the 19th century (especially Comte and Spencer), we could still call this research a 'sociological study.' However, subsequently, sociology has strictly defined its object of study and research techniques, differentiating itself from other social sciences or disciplines such as history, economics, ethics, politics, and future studies.

The change in scope that characterizes the shift from classic to contemporary sociology has already been noticed by Florian Znaniecki (1934: v-iv) in his book *The Method of Sociology*. Znaniecki writes: "Now, sociology is passing through a crisis as deep as any science ever passed through. It was established as a synthetic science of 'society' or 'civilization,' using the results of several other sciences to draw such comprehensive generalizations as none of those sciences could or cared to draw for itself. It is changing into an analytic science investigating directly and independently particular empirical data, formulating its own results in a vast monographic literature, and not only avoiding hasty conclusions, but often mistrusting generalization more than other sciences do, and more than is good for any science."

Moreover, Max Weber notoriously proposed a rigid distinction between explanatory theories and normative theories, making of only the first the goal of sociology. This has been remarked, for instance, by the *Oxford Dictionary of Sociology*, which defines 'normative theories' as "hypotheses or other statements about what is right and wrong, desirable or undesirable, just or unjust in society," and points out that "the majority of sociologists consider it illegitimate to move from explanation to evaluation. In their view, sociology should strive to be value-free, objective, or at least to avoid making explicit value-judgements. This is because, according to the most popular philosophies of the social sciences, conflicts over values cannot be settled factually. Moral pronouncements cannot be objectively shown to be true or false, since value-judgements are subjective preferences, outside the realm of rational inquiry" (Marshall 2003).

Sometimes, this position has been taken too far, failing to recognize that Max Weber (2008, 46–7) was mainly talking about being neutral while teaching in the classroom – that is, avoiding behaving as a guru inside the walls of academy. To act as such a guru would have been 'unfair,' because students were asked to be passive listeners. Therefore, shifting from the objective ground of fact-statements to the subjective field of value-judgements could result in a kind of moral 'violence.' However, Weber openly stated that outside the classroom – i.e. in public conferences or in books – a social scientist could also engage in discussions about "what to do," and not only "what is or is not."

It is true that social science is different from social policy from a logical and methodological point of view, but it is also quite clear that the one needs the other. Applied sociology needs theoretical sociology, as robotic engineering needs theoretical physics. Contrarily to what most people assume, robotic engineering – as any type of engineering – is not value-free. It is value-laden no less than social policy or applied sociology, because it changes the world and the lifestyle of people, and very often it does it in a more radical way than social policies. One can argue, however, that social scientists tend to be more conscious than engineers about the political implications and the social consequences of their applications.

The main task of a sociologist is to reconstruct facts and unveil hidden mechanisms that establish a causal relation between certain actions and certain consequences. A sociologist does not venture into statements as to what humans ought to do on the basis of an ethical code or a political doctrine. If (s)he did, (s)he would be a moralist or a politician. Nevertheless – and this is what sociotechnology or social engineering consists of – a sociologist can still evaluate the lines of action from a chiefly technical point of view. For example, (s)he can say if the means M, adopted by agent A, in order to reach the objectives O1, O2, O3…On, is adequate or not in the light of the situation S in which the agent has to make a decision. In this case the evaluation is technical, not moral, because it is concerned with the means, not the ends. An Italian proverb speaks to this tense between the analyses of means and ends: "Non puoi avere la botte piena e la moglie ubriaca" ("one cannot have a full bottle and a drunk wife"). The sociologist will not tell a married man that he should give his wife a bottle of champagne, or that he would do better to save the money. But (s)he may be able to evaluate the efficiency of this man's strategies, whatever these may be, based on the observation that one cannot have a full bottle and a drunk wife. This is also what the physicist does when (s)he uses knowledge to modify reality, by elaborating theories that will be useful to build machines. In this case we call him an engineer, and certainly not a moralist, even if what he does has profound consequences on the life of a lot of people.

In spite of the fact that – given a certain definition of sociology – this work could be categorized as sociological, I decided to opt for a different title in order to avoid the endless epistemological and methodological discussions that surround sociology. We are not here to decide what sociology is or is not, what it should be or should not be, or if sociology is a real science or not. Labelling this work a "sociological study" could divert the attention from the real focus of this book: robots and their interactions with humans. Besides, I am comforted by the fact that interdisciplinary "social studies of science and technology" have already an established tradition inside the academic world.

This book has been composed by assembling and organizing essays and articles already published in English or Italian in scientific and academic journals. That is why the reader may find some concepts to be repeated in different parts of the book. This was a conscious decision made while compiling the various essays and articles, as each chapter is intended to be autonomous, with its own narrative structure. If concepts are repeated in different contexts that means that they are important within the given discussion and will helpful for the reader. This does not mean that those articles and fragments already published were left untouched. Robotics is rapidly evolving, therefore articles published two or three years ago often needed a 'face-lift,' that would take into account new direct observations or more recent secondary literature on the topic.

Chapter 1 is entitled "Engineers and Automata."[1] Its purpose is to examine some of the projects on which robotic engineers are presently working, and to explore the dreams and hopes connected with these undertakings. Here I offer some general information about robots and their origins, some technical information about the difference between the top-down and the bottom-up approaches to robotics, and I show how robotic engineers are incorporating a social understanding of robots. Finally, I explore the most recent literature on social robotics and argue that this interdiscipline is evolving in a direction that will soon require a systematic collaboration between engineers and social scientists.

Chapter 2 is entitled "Workers and Automata."[2] Its aim is to determine if there is a relation between automation and unemployment within the Italian socio-economic system. Technological unemployment is a long time debated problem.

---

1 Originally published in Italian as "Nascita e sviluppo della robotica" (Campa 2011, section 1.1.), with the exclusion of the section "The Rise of Social Robots," which is still unpublished.

2 Originally published in *Journal of Evolution and Technology* as "Workers and Automata. A Sociological Analysis of the Italian Case" (Campa 2014a).

One possible definition of technological unemployment is "unemployment due to our discovery of means of economising the use of labour outrunning the pace at which we can find new uses for labour" (Keynes 1930). The discussion about this phenomenon goes back at least to the beginning of the industrial revolution and the birth of Classical political economy.[3]

In Europe Italy has the second highest rate of robot density and the fourth highest rate in the world. Among the G7 it is the nation with the highest rate of youth unemployment. Establishing the ultimate causes of unemployment is a very difficult task, and the notion itself of 'technological unemployment' is controversial. Mainstream economics tends to relate the high rate of unemployment that characterizes Italian society with the low flexibility of the labour market and the high cost of manpower. Little attention is paid to the impact of artificial intelligence on rates of employment. With reference to statistical data, we will try to show that automation can be seen at least as a contributory cause of unemployment. In addition, we will argue that both Luddism and anti-Luddism are two faces of the same coin. In both cases attention is focused on technology itself (the means of production) instead of on the system (the mode of production). Banning robots or denying the problems of robotization are not effective solutions. A better approach would consist in combining growing automation with a more rational redistribution of income.

---

3 One of the first scholars to study systematically technological unemployment was David Ricardo. Initially, Ricardo denies the problem. He maintains that the introduction of machinery is beneficial to all classes of society. He formulates what has been defined as "the first satisfactory statement of the theory of 'automatic compensation'" (Blaug 1958, 66). Other thinkers (among them: Say, Sismondi, and Malthus) oppose this view. Subsequently, "Ricardo retracted his former opinion on the subject" (Kurz 1984), shocking his own followers. Indeed, the idea "that the substitution of machinery for human labour, is often very injurious to the interests of the class of labourers" can be found in chapter XXXI, "On Machinery," in the third edition of Ricardo's *Principles*, published in 1821 (Ricardo 2004). This way, the idea of technological unemployment "marks its first appearance in respectable economic literature" (Kurz 1984; see also Lowe 1976, 250). As a matter of fact, the Luddites were denouncing this problem since long time, but only with Ricardo's classical economy, technological unemployment enters the 'world of ideas.' Karl Marx has also noticed that machinery did not free humans from labour, but rather caused unemployment on the one hand and the inhumane exploitation of those still employed on the other hand. Quite significantly, Marx praises Ricardo's "scientific impartiality and love of truth" (Marx 1976, 565). Similarly, Lowe (1954, 142) will characterize the chapter "On Machinery" by Ricardo as "a rare case of self-destructive intellectual honesty."

Chapter 3 is entitled "Citizens and Automata."[4] The aim of this chapter is to explore the possible futures generated by the development of artificial intelligence. Our focus will be on the social consequences of automation and robotization, with special attention being paid to the problem of unemployment. In spite of the fact that this investigation is mainly speculative in character, we will try to develop our analysis in a methodologically sound way. To start, we will make clear that the relation between technology and structural unemployment is still controversial. Therefore, the hypothetical character of this relation must be fully recognized.[5] Secondly, as proper scenario analysis requires, we will not limit ourselves to predict a unique future, but we will extrapolate from present data at least four different possible developments: 1) unplanned end of work scenario; 2) planned end of robots scenario; 3) unplanned end of robots scenario, and 4) planned end of work scenario. Finally, we will relate the possible developments not just to observed trends but also to social and industrial policies presently at work in our society, which may change the course of these trends.

Chapter 4 is entitled "Roboethicists and Automata."[6] Here we attempt to outline the core ideas of roboethics, that is, of ethical analysis as applied to robotics. First of all, we make some general remarks about the purpose and origins of this field, after which we move on to the normative aspects. We then define our ethical perspective as a whole and propose a 'rational' and 'pragmatic' approach to moral problems. Briefly, this approach consists in positing the 'good,' as understood as 'happiness,' as the fundamental value of ethics (in agreement with the Greek philosophical tradition), then rationally working out the behavioural norms that ought to lead to this 'good' and, finally, empirically and pragmatically assessing if respecting these norms *de facto* allows us to attain this end. If this is not the case it will be necessary to rationally reformulate the norms. We will then explore the main points of two well-known codes of roboethics: Asimov's "Three Laws of Robotics" and the "Euron Code." We have established that, given our rational and pragmatic standpoint, the Euron Code is the most suitable code for the regulation of military robotics. Essentially it boils down to five basic recommendations: *Safety* (control by humans); *Security* (preventing illegal use); *Privacy*

4 Originally published in *Journal of Evolution and Technology* as "Technological Growth and Unemployment: A Global Scenario Analysis" (Campa 2014b).

5 Indeed, a variety of factors have been indicated as determinants of unemployment (Gangl 2003, Malinvaud 1994, Reutter 2001, Rubart 2007, Sonnenberg 2014, Howell 2005, Stockhammer 2004, Gordon 2004, Groot 2004, Giugni 2009, Werding 2006, Salvadori & Balducci 2005, Ostrup 2003, Vroman & Brusentsev 2005, Hughes 2014).

6 Originally published in Italian as "Principi di roboetica" (Campa 2011, chapter 2).

(protection of data collected by the robot); *Traceability* (recording every activity carried out by the robot); and *Identifiability* (attribution of a secure and registered identity to every single robot). These recommendations are still compatible with a belligerent use of suitably regulated robots. On the contrary, Asimov's laws simply reject the possibility of using robots in warfare: indeed the first law states that "A robot may not injure a human being or, through inaction, allow a human being to come to harm" (without distinction between friends and enemies). Finally we tackle the legal mess arising from the problem of the juridical responsibility of robot behaviour, which can be fall under many subjects: the designer, the builder, the owner, the user, and – in an evolutionist perspective – the robot itself.

Chapter 5 is entitled "Soldiers and Automata."[7] The purpose of this chapter is to examine systems of military robots (or robotized weapons), with special emphasis on the ethical issues already raised by the design, construction and utilization of these technological objects, as well as on the possible future development of these systems of weaponry and of the new ethical problems they lead to. We will explore the field of military robotics in more detail, along the way pointing out the features of the models of robotic weapons currently in use on the battle field or in the stage of prototypes. We will give particular attention to the function of these machines and to the specific needs expressed by the soldiers using them. Our information comes from newspaper articles, books and documents compiled by military authorities. The *Unmanned System Roadmap* published by the United States Department of Defense stands out for its informative and futurological perspective, and is therefore particularly useful.

Then, we proceed by examining ethical problems of military roboethics. We go into further detail and apply the ethical norms that we worked out and discussed in chapter four to the robotized weapons presented and analysed in the first part of chapter five. Initially we reconstruct the main objections advanced by experts against a belligerent use of robots. First of all we outline Noal Sharkey's plea for an international moratorium, which has been echoed in the press. Then we take a look at the worries, expounded by some thinkers, that robots belong neither to the category of inanimate objects nor to that of sentient beings, and that there could therefore be war crimes without war criminals. Finally we analyse a number of current and hypothetical problems expounded by Peter W. Singer. Among these are a) the trivialization of war due to remotely piloted "Unmanned Aircraft Systems" (such as the "Predator"); b) the rise of "war porn" because robotic weapons

7 Originally published in Italian as "La robotica militare," "Problemi etici della robotica militare," and "Uno sguardo al futuro" (Campa 2011, section 1.2, chapters 3 and 4).

record war action, with the footage ending up online and thereby whetting sick voyeurism in the viewers; c) the possible multiplication of conflicts because of the indifference of ordinary people who will no longer have to give their lives, no longer be subjected to rationing, no longer pay war tax, no longer be called to vote for war intervention.

Once we have highlighted these various problems we come to the defence of our own standpoint. So, in the last pages of the book we will openly shift from an analytical-descriptive perspective to an axiological-normative one. Regarding the many proposals to ban or imposing moratoriums on military robots, among which Sharkey's is just the most well known, we observe that these suggestions are unrealistic and impracticable. Indeed the arms race is a typical case of the game theory known as "the prisoner's dilemma." Even if one could rationally argue in favour of the adoption by the various manufacturers of a very restrictive precautionary principle, the effective lack of mutual trust between nation states will induce them to go for the option that carries least individual (and not global) risk: namely, the construction of ever more powerful robotic weapons. In my humble opinion, it is less unrealistic – and certainly more advisable – to initiate negotiations that purport not so much to block the research and development of military robots, but to regulate their actual use on the battlefield. This sort of convention has already been agreed upon and respected in the case of other systems of weaponry. This suggests that this approach is more practicable. In addition it is certainly possible to lay down strict rules relative to the identification and the traceability of the robots that give exact information regarding to whom they belong, whose responsibility they are, where they are located, what they are doing and what they have done. This ought to limit the damage due to the possible illegal use of these weapons by organized criminals or terrorist groups.

As regards voyeurism and "war porn," we will see that new technologies amplify these problems, but do not cause them. Anthropology teaches us that man is no angel, but a morally ambivalent being: on the one hand he is capable of remorse, compassion, altruism, but on the other he still remains the most ruthless predator to have appeared on planet Earth. In particular, unlike many other predators, he has proven able to kill for sheer pleasure or in revenge. Nevertheless it is precisely man's ambivalent nature that should induce us to also consider the possibility that the footages of robot soldiers might act as an antidote to the multiplication of conflicts, sensitising public opinion, and causing improper use to stir indignation.

The fact that man is by definition no angel should make us view the question of "control" by humans in a different light. This first point of the Euron Code is indeed the one that seems to require the most critical thinking if it is to serve as a

source of efficient implemental norms. The dogma of "human control" risks becoming an obstacle, unless one takes two fundamental questions into account: 1) it is necessary to clarify what one means by "human control" (remote control? A veto on certain actions? The ability to incapacitate the robot at any time? The ability to switch it off given to any human being or only to the legitimate owner, to the manufacturers, to the users, to agencies of law enforcement?); 2) it is always necessary to keep in mind that mobsters and terrorists are *humans* and may gain *control* over such technology.

To sum up, we propose a different approach, one that is statistical and pragmatic. Given that human beings make mistakes (via inexperience, friendly fire, cruelty, pointless violence, torture, etc.), and given that even in war "control by humans" might become impracticable (maximum robot autonomy might confer military superiority over the adversary), it is better to avoid fixating on this principle. I think that it is more rational to allow machines increasing room for autonomy and use statistics to evaluate whether they commit more or fewer mistakes than humans. This will allow for the development of more sophisticated prototypes and for the further development of functional autonomy.

Finally, we will venture into futurology, and try to imagine forms and functions of future robots, with a particular attention to possible military use. We will examine the reasons that make us believe where we are heading. Basic reasons are the optimal performance of current robots, the increasing faith of the army in these machines and the requirements of its commanders (that the Department of Defense promptly transmits to designers and manufacturers). The synergy between the army, politicians and the private manufacturing sector suggests that this trend is unlikely to change. It may, however, possibly slow down because of unforeseen developments (the financial crisis, the withdrawal from Iraq, etc.). The two main innovations of the future will be the miniaturization of 'unmanned systems,' linked to the development of nanotechnology, and the emergence of robots with ever more human-like shapes and behaviours, the so-called 'androids.' These technologies – anticipated by scientists, futurists and writers of science fiction – will bring about hitherto unseen opportunities and dangers.

We will also examine a series of reasons why the robotic arms race is unlikely to end in the extinction of the human race (as predicted by works of science fiction like *The Terminator* or *The Matrix* or insome recent newspaper articles). However, while the apocalyptic outcome may be improbable, it is certainly not impossible. Faced with this uncertainty, in order to ethically justify the choice of going ahead with the further development of this technology, we will rely on the logical insufficiency of the precautionary principle, which does not give enough credit to all the benefits that may come from the development of robotics. In addition, I will

make a recommendation that can be summed up as follows: it is not advantageous to halt technological progress, including that of military robots, but it is rational to develop lines of parallel research, the goal of which is to design technologies that will be able to counterbalance those harmful outcomes. To put it as a slogan: *any drug can become a poison, therefore every poison needs to have its antidote.*

Acknowledgments

I am beholden to the Jagiellonian University in Krakow, Poland – my academic home – for having granted me the academic freedom required for intellectual exploration and heterodoxy. I am grateful to the Institute for Ethics and Emerging Technologies (IEET) for having started a stimulating debate on robotization and technological unemployment, and in particular to its director James Hughes. I thank the Military Centre for Strategic Studies (Centro Militare Studi Strategici – Ce.Mi.S.S.) of the Italian Ministry of Defence for having appointed me director of a research project on robotic weapons and hostile artificial intelligence. In particular, I thank Italian Air Force colonel Volfango Pierluigi Monaci for having read and reviewed my research. A debt of gratitude is also due to the Industrial Research Institute for Automation and Measurements (Przemy-słowy Instytut Automatyki i Pomiarów – PIAP) in Warsaw for having invited me to collaborate within their RoboScope seminar, which provided me the opportunity to learn much about the perspectives of engineers and military personnel on the use of robots within special operations.

I am grateful to Stefan Lorenz Sorgner for his sustained encouragement and his patience; Luciano Pellicani, Warren Breckman, Mario Bunge, Piotr Sztompka, Michael Burawoy, Neil Smelser, Jeffrey Alexander, Lech Witkowski, Kazimierz Krzysztofek, Krzysztof Frysztacki, Jarosław Górniak, Michel Kowalewicz, Maria Flis, and Anthony Giddens for stimulating discussions which have helped to broaden my knowledge on social and cultural processes.

I am particularly indebted to Catarina Lamm for having translated my Italian writings on robotics and for having encouraged me to publish a book in English on this topic. This book would not exist without her initiative. I am also grateful to Matt Hammond and Lucas Mazur for having proofread various parts of the book. It goes without saying that any remaining inaccuracies in the facts or in the style are my own.

Last, but not least, I thank my little son Leonardo for his spontaneous and contagious fascination with robots and machinery, and for his many questions about the future that he will inhabit.

I dedicate this book to the memory of my master and teacher Robert K. Merton (1910–2003) sociologist, methodologist, historian of ideas, and outstanding student of science, technology and society.

Bibliography

AdnKronos, 2009, August 21. "Creato EATR, robot da guerra che può nutrirsi di carne: s'infiamma il dibattito sulla cyber-etica," *AdnKronos*.

Ahmed, A. 2013. *The Thistle and the Drone. How America's War on Terror Became a Global War on Tribal Islam*. Washington D.C.: Brookings Institution Press.

Aridas, T. and Pasquali, V. 2013, March 7. "Countries with the Highest GDP Average Growth, 2003–2013," *Global Finance*.

Aristotle, 1995 (350 B.C.E.). *Politics,* Books I and II. Oxford: Clarendon Press.

Ayres, R. U. 1998. *Turning Point. The End of the Growth Paradigm*. London: Earthscan Publications.

Bashir, S. and Crews, R. D. (eds.) 2012. *Under the Drones. Modern Lives in the Afghanistan-Pakistan Borderlands*. Cambridge (MA) and London: Harvard University Press.

Bennato, D. 2004, April 19. "Roboetica: un caso emblematico di tecnoetica." www.tecnoetica.it (accessed January 1, 2011).

Bignami, L. 2007, April 10. "Robot, la grande invasione," *La Repubblica*.

Blaug, M. 1958. *Ricardian Economics.* New Haven: Yale University Press.

Blaug, M. 1978. *Economic Theory in Retrospect*. Cambridge: Cambridge University Press.

Bonaccorso, G. 2004. "Roboetica: tra fantascienza e realtà. Analisi critica delle tre leggi di Asimov." www.psicolab.net (accessed January 1, 2011).

Bonaccorso, G. 2011. *Saggi sull'Intelligenza Artificiale e la filosofia della mente*. Morrisville: Lulu.com.

Boyer, R. 2012. "The four fallacies of contemporary austerity policies: the lost Keynesian legacy," *Cambridge Journal of Economics*, 36 (1), 283–312.

Brown, A. 2009, March 18. "War crimes and killer robots," *The Guardian*.

Calvino, I. 1962. *The Nonexistent Knight and The Cloven Viscount*. San Diego: Harcourt Brace Jovanovich.

Campa, R. 2004. "La *Storia filosofica dei secoli futuri* di Ippolito Nievo come caso esemplare di letteratura dell'immaginario sociale: un esercizio di critica sociologica," *Romanica Cracovensia,* 4, 29–42.

Campa, R. 2006. "Transumanesimo," *Mondoperaio*, N. 4–5, July-October, 148–153.

Campa, R. 2007. "Considerazioni sulla terza rivoluzione industriale," *Il Pensiero Economico Moderno,* Anno XXVII, N. 3, July-September.

Campa, R. 2010a. "Le radici pagane della rivoluzione biopolitica," in Id. (ed.), *Divenire. Rassegna di studi interdisciplinari sulla tecnica e il postumano,* vol. 4. Bergamo: Sestante Edizioni.

Campa, R. 2010b. *Mutare o perire. La sfida del transumanesimo*. Bergamo: Sestante Edizioni.

Campa, R. 2011. *Le armi robotizzate del futuro. Intelligenza artificialmente ostile? Il problema etico*. Roma: CEMISS.

Campa, R. 2014a. "Workers and Automata. A Sociological Analysis of the Italian Case," *Journal of Evolution and Technology*, Vol. 24 Issue 1, February, 70–85.

Campa, R. 2014b. "Technological Growth and Unemployment: A Global Scenario Analysis," *Journal of Evolution and Technology*, Vol. 24 Issue 1, February, 86–103.

Čapek, K. 2004 (1921). *R.U.R. (Rossum's Universal Robots)*. London: Penguin Books.

Cappella, F. 2008, March 20. "Big Dog," *Neapolis*.

Carr, A. Z. 1968. "Is Business Bluffing Ethical?," *Harvard Business Review*, January-February, 2–8.

Chomsky, N. and Vltchek, A. 2013. *On Western Terrorism. From Hiroshima to Drone Warfare*. London: Pluto Press.

Clapper, J. R., Young, J. J., Cartwright, J. E., and Grimes, J. G. 2007. *Unmanned Systems Roadmap 2007–2032,* Department of Defense (USA).

Clapper, J. R., Young, J. J., Cartwright, J. E., and Grimes, J. G. 2009. *Unmanned Systems Roadmap 2009–2034,* Department of Defense (USA).

Corriere della sera, 2003, July 29. "Un robot dipinge guidato da un cervello di topo," *Corriere della sera*.

Daerden, F., and Lefeber, D. 2000. "Pneumatic Artificial Muscles: actuators for robotics and automation," Vrije Universiteit Brussel. http://lucy.vub.ac.be (accessed February 27, 2015).

Desai, J. P., Dudek, G., Khatib, O., and Kumar V. (eds.) 2013. *Experimental Robotics*. Heidelberg: Springer.

Devereux, T. 1993. *La guerra elettronica: arma vincente 1812–1992.* Varese: Sugarco Edizioni.

Di Nicola, P. 1998. "Recensione: Luciano Gallino, *Se tre milioni vi sembran pochi. Sui modi per combattere la disoccupazione.*" http://www.dinicola.it (accessed April 2, 2015).

Eurostat, 2009. *Science, technology and innovation in Europe.* ec.europa.eu (accessed May 15, 2015).

Evangelista, M. and Shue, H. (eds.) 2014. *The American Way of Bombing. Changing Ethical and Legal Norms, from Flying Fortresses to Drones*. Ithaca and London: Cornell University Press.

Feletig, P. 2010, February 1. "Robot per mare, per cielo e per terra ormai in guerra si va senza uomini," *la Repubblica*.

Fitter, N. T. and Nichols, P. M. 2015. "Applying the Capability Approach to the Ethical Design of Robots." www.openroboethics.org (accessed May 15, 2015).

Floreano, D., and Mattiussi, C. 2008. *Bio-Inspired Artificial Intelligence. Theories, Methods, and Technologies*. Cambridge: The MIT Press.

Ford, M. 2009. *The lights in the Tunnel. Automation, Accelerating Technology and the Economy of the Future*. Acculant Publishing. thelightsinthetunnel.com (accessed April 2, 2015).

G. G. 2008, February 27. "Fermare la corsa alle armi robotiche. Un appello degli esperti di robotica contro il rischio di proliferazione di questi nuovi strumenti di morte," *Le Scienze. Edizione Italiana di Scientific American*.

Gallino, L. 1998. *Se tre millioni vi sembrano pochi. Sui modi per combattere la disoccupazione.* Torino: Einaudi.

Gallino, L. 1999, January 13. "Disoccupazione tecnologica: quanta e quale perdita di posti di lavoro può essere attribuita alle nuove tecnologie informatiche," *MediaMente Biblioteca Digitale*. www.mediamente.rai.it (accessed April 2, 2015).

Gallino, L. 2003. *La scomparsa dell'Italia industriale.* Torino: Einaudi.

Ganapati, P. 2009, July 22. "Robo-Ethicists Want to Revamp Asimov's 3 Laws," *Wired*.

Gangl, M. 2003. *Unemployment Dynamics in the United States and West Germany. Economic Restructuring, Institutions and Labor Market Processes*, Berlin Heidelberg: Springer Verlag.

Ge, S. S., Khatib, O., Cabibihan, J.-J., Simmons, R., Williams, M.-A. (eds.) 2012. *Social Robotics. Fouth International Conference. Proceedings*. Heidelberg: Springer.

Ge, S. S., Li, H., Cabibihan, J.-J., and Tan, Y. K. (eds.) 2010. *Social Robotics. Second International Conference. Proceedings.* Heidelberg: Springer.

Geroni, A. 2011, March 9. "Trenta fallimenti al giorno," *Il Sole 24Ore*.

Giavazzi F. and Pagano, M. 1990. "Can Severe Fiscal Contractions be Expansionary? Tales of Two Small European Countries," *NBER Macroeconomics Annual*, 5, 75–111.

Giugni, M. (ed.) 2009. *The Politics of Unemployment in Europe. Policy Responses and Collective Action.* Farnham: Ashgate Publishing Limited.

Gordon, R. J. 2004. *Productivity Growth, Inflation, and Unemployment. The Collected Essays of Robert J. Gordon*. Cambridge: Cambridge University Press.

Graeber, D. 2013, August 17. "On the Phenomenon of Bullshit Jobs," *Strike! Magazine*.

Groot, L. 2004. *Basic Income, Unemployment and Compensatory Justice*, New York: Springer Science+Business Media.

Gunkel, D. J. 2012. *The Machine Question. Critical Perspectives on AI, Robots, and Ethics*. Cambridge (MA) and London: The MIT Press.

Habermas, J. 2003. *The Future of Human Nature.* Cambridge: Polity Press.

Habershon, E., and Woods, R. 2006, June 18. "No sex please, robot, just clean the floor," *The Sunday Times*.

Haddadin, S. 2014. *Towards Safe Robots. Approaching Asimov's 1st Law*. Heidelberg: Springer.

Harnad, S. 2003, "Can a Machine Be Conscious? How?," *Journal of Consciousness Studies* 10 (4), 67–75.

Hermann, G., Pearson, M. J., Lenz, A., Bremner, P., Spiers, A., and Leonards U. (eds.) 2012. *Social Robotics. Fifth International Conference. Proceedings*. Heidelberg: Springer.

Heron, 1976 (1899–1914). *Heronis Alexandrini opera quae supersunt omnia*, 5 vol., Leipzig, Teubner.

Horgan, J. 1997. *The end of science. Facing the Limits of Knowledge in the Twilight of the Scientific Age.* New York: Broadway Books.

Howell, D. R. (ed.) 2005. *Fighting Unemployment. The Limits of Free Market Orthodoxy*, Oxford: Oxford University Press.

Hughes, J. (ed.) 2014. *Technological Unemployment and the Basic Income Guarantee*, Special issue of *The Journal of Evolution and Technology*, Volume 24 Issue 1.

Hughes, J. 2004. "Embrace the End of Work. Unless we send humanity on a permanent paid vacation, the future could get very bleak," *USBIG Discussion Paper No. 81*. www.usbig.net (accessed April 2, 2015).

Istat, 2010. *La popolazione straniera residente in Italia al 1 gennaio 2010*, October 12. www.istat.it (accessed April 2, 2015).

Istat, 2011. *Censimento dell'Industria e dei Servizi*. www.istat.it (accessed April 2, 2015).

Kanda, T., and Ishiguru H. 2013. *Human-Robot Interaction in Social Robotics*. Boca Raton: CRC Press.

Keynes, J. M. 1930. "Economic Possibilities for our Grandchildren." In: Idem, *Essays in Persuasion*, New York: W. Norton & Co., 358–373.

Kramer, S. N. 1997. *I Sumeri. Alle radici della storia,* Newton, Roma [English title: *History Begins At Sumer,* University of Pennsylvania Press, 1988.].

Krugman P. 2013, June 13. "Sympathy for the Luddites," *New York Times*.

Kurfess, T. R. (ed.) 2012. *Robotics and Automation Handbook*. CRC Press. Kindle Edition.

Kurz, H. D. 1984. "Ricardo and Lowe on Machinery," *Eastern Economic Journal* Vol. 10 (2), April June, 211–229.

Lin, P., Abney, K. and Bekey, G. A. (eds.) 2012. *Robot Ethics. The Ethical and Social Implications of Robotics*. Cambridge (MA): MIT Press.

Lira, 2015. "Babybot on the Press." http://www.lira.dist.unige.it (accessed April 6, 2015).

Liu, Y., and Sun, D. 2012. *Biological Inspired Robotics*. Boca Raton: CRC Press.

Lowe, A. 1954. "The Classical Theory of Economic Growth," *Social Research*, Vol. 21, 127–158.

Lowe, A. 1976. *The Path of Economic Growth*. Cambridge: Cambridge University Press.

Malinvaud, E. 1994. *Diagnosing unemployment*. Cambridge: Cambridge University Press.

Marshall, G. 2003. *Oxford Dictionary of Sociology*. Oxford: Oxford University Press.

Martorella, C. 2002, October 5. "Shigoto. Lavoro, qualità totale e rivoluzione industriale giapponese." http://cristiano-martorella-archivio.blogspot.com (accessed April 2, 2015).

Maruccia, A. 2010, February 28. "Era del Robot, umanità in pericolo," *Punto Informatico*.

Marx, K. 1976 (1867). *Capital. A Critique of Political Economy*, Vol. 1, Harmondsworth and New York: Penguin Books.

Marx, K. and Engels F. 1948 (1888). *Manifesto of the Communist Party*, New York: International Publishers.

Meggiato, R. 2010, July 16. "EATR il robot vegetariano. Sviluppato il primo robot in grado di alimentarsi da sé con dei vegetali," *Wired*.

Menghini, M., and Travaglia M. L. 2010. *L'evoluzione dell'industria italiana. Peculiarità territoriali. Istituto Guglielmo Tagliacarne*. www.tagliacarne.it (accessed April 2, 2015).

Merton, R. K. 1936. "The unanticipated consequences of purposive social action," *American Sociological Review*, 1, 894–904.

Merton, R. K. 1968. *Social Theory and Social Structure*. New York: Free Press.

Mill, J. S. 1848. *Principles of Political Economy with some of their Applications to Social Philosophy*. www.econlib.org (accessed April 2, 2015).

Minsky, M. 1956. Some Universal Elements for Finite Automata. *Automata Studies: Annals of Mathematics Studies*, Number 34.

Monopoli, A. 2005. *Roboetica. Etica applicata alla robotica*. www.roboetica.it (accessed April 2, 2015).

Monopoli, A. 2007. *Roboetica. Spunti di riflessione*. Morrisville: Lulu.com.

Moravec, H. 1993. "The Age of Robots." www.frc.ri.cmu.edu (accessed April 2, 2015).

Moravec, H. 1993. "The Universal Robot," *Siemens Review*, v. 60/1, January/February, 36–41.

Moravec, H. 1995. "Bodies, Robots, Minds," www.frc.ri.cmu.edu (accessed April 2, 2015).

Moravec, H. 1997. "When will computer hardware match the human brain?," www.transhumanist.com (accessed April 2, 2015).

Mutlu, B., Bartneck, C., Ham, J., Evers, V., and Kanda T. (eds.) 2011. *Social Robotics. Third International Conference. Proceedings*. Heidelberg: Springer.

Nadotti, C. 2006, May 29. "Tokyo prepara le regole per i robot: Non danneggino gli esseri umani," *La Repubblica*.

Nath, V. and Levinson, S. E. 2014. *Autonomous Military Robotics.* Heidelberg: Springer.

New Scientist, 1980. "Car firm drives toward new robot technology," *New Scientist,* June 12, Vol. 86, No. 1205.

Nichols, M. 2013, August 1. "Italian firm to provide surveillance drone for U.N. in Congo," *Reuters*.

Noble, D. F. 1995. *Progress without People.* New Technology, Unemployment, and the Message of Resistance. Toronto: Between the Lines.

Northrop Grumman, "X-47B UCAS Makes Aviation History…Again! Successfully Completes First Ever Autonomous Aerial Refueling Demonstration." www.northropgrumman.com (accessed May 13, 2015).

Operto, F. 2004. "Roboetica da tutto il mondo," *Fondazione Informa,* 6, n. 1. www.fondazionecarige.it (accessed January 1, 2011).

Ostrup, F. 2003. *Money and the Natural Rate of Unemployment*. Cambridge: Cambridge University Press.

Page, L. 2008, April 11. "US war robots in Iraq 'turned guns' on fleshy comrades," *The Register*.

Paprotny, I., and Bergbreiter, S. 2014. *Small-Scale Robotics: From Nano-to-Millimeter-Sized Robotic Systems and Applications*. Heidelberg: Springer.

Pellicani, L. 2007. *Le radici pagane dell'Europa*. Soveria Mannelli: Rubbettino.

Petroni, A. M. 2009. "Liberalismo e progresso biomedico: una visione positiva." In: R. Campa (ed.), *Divenire. Rassegna di studi interdisciplinari sulla tecnica e il postumano, Vol. 2*. Bergamo: Sestante Edizioni, 9–43.

Polchi, V. 2011, March 11. "Il governo ora chiede più immigrati," *La Repubblica*.

Polidori, A. 2004. "Babybot, bimbo artificiale," *Gabinus Rivista Culturale,* II, n. 2. www.lira.dist.unige.it (accessed April 2, 2015).

Potter, S., DeMarse, T. B., Wagenaar, D. A., and Blau, A. W. 2001. "The Neurally Controlled Animat: Biological Brains Acting with Simulated Bodies," *Auton Robots*, 11(3), 305–310.

Poundstone, W. 1992. *Prisoner's Dilemma*. New York: Doubleday.

Punto Informatico, 2006, June 20. "I robot dovranno seguire un codice etico", *Punto Informatico*.

Putnam, H. 1964. "Robots: Machines or Artificially Created Life?," *Journal of Philosophy*, 61 (November), 668–91.

R. Z., 2009, July 17. "Tecnologie inquietanti, il Pentagono studia robot da guerra che si nutrono di cadaveri," *Tiscali Notizie*.

Rampini, F. 2003, May 18. "Il robot col cervello di un topo," *La Repubblica*.

Ranisch, R. and Sorgner, S. L. (eds.) 2014. *Post- and Transhumanism. An Introduction*. Frankfurt am Main: Peter Lang Edition.

Relke, D. M. A. 2006. *Drones, Clones, and Alpha Babes. Retrofitting Star Trek's Humanism, Post-9/11*. Calgary: University of Calgary Press.

Reutter, M. 2001. *A Macroeconomic Model of West German Unemployment. Theory and Evidence*. Heidelberg: Springer.

Ricardo, D. 2004 [1821]. *On the Principles of Political Economy and Taxation. Third edition*. Kitchener: Batoche Books.

Rifkin, J. 1995. *The End of Work. The Decline of the Global Labor Force and the Dawn of the Post-Market Era*. New York: Putnam Publishing Group.

Riotta, G. 2005, October 10. "Il filosofo Fukuyama mette in guardia sui rischi di una ricerca senza limiti: 'No a ingegneria genetica come a fascismo e comunismo,'" *Corriere della sera*.

Rogers, A. and Hill, J. 2014. *Unmanned. Drone Warfare and Global Security.* London: Pluto Press.

Rubart, J. 2007. *The Employment Effects of Technological Change. Heterogenous Labor, Wage Inequality and Unemployment*. Berlin Heidelberg: Springer.

Russo, L. 2004. *The Forgotten Revolution. How Science Was Born in 300 BC and Why It Had to Be Reborn*. Berlin: Springer.

Russo, M., and Pirani, E. 2006. "Dinamica spaziale dell'occupazione dell'industria meccanica in Italia 1951–2001." www.academia.edu (accessed April 2, 2015).

Salvadori, N., and Balducci, R. (eds.) 2005. *Innovation, Unemployment and Policy in the Theories of Growth and Distribution*. Northampton Massachusetts: Edward Elgar Publishing Limited.

Sanchez, M. 2009. "Robots Take Center Stage in U.S. War in Afghanistan," March 23. www.foxnews.com (accessed April 2, 2015).

Schor, J. B. 1993. "Pre-industrial workers had a shorter workweek than today's," http://groups.csail.mit.edu (accessed April 2, 2015).

Schor, J. B. 1993. *The Overworked American: The Unexpected Decline of Leisure*. New York: Basic Books.

Scuola di robotica, 2011. *Roboetica*. www.scuoladirobotica.it (accessed January 1, 2011).

Serreli, V., Lee, C., Kay, E. R., and Leigh, D. 2007. "A molecular information ratchet," *Nature*, February 1, 445, 523–7.

Sharkey, N. 2007, August 18. "Robot wars are a realityArmies want to give the power of life and death to machines without reason or conscience," *The Guardian*.

Sharkey, N. 2008a. "Ground for discrimination. Autonomous Robot Weapons," *RUSI Defence Systems*, October, 86–89.

Sharkey, N. 2008b. "The Ethical Frontiers of Robotics," *Science*, Vol. 322, no. 5909, December 19, 1800–1.

Shin, D., Yeh, X., Narita, T., and Khatib, O. 2013. "Motor vs. Brake: Comparative Studies on Performance and Safety in Hybrid Actuations." In: Desai, J. P., et al. (eds.) 2013. *Experimental Robotics.* Heidelberg: Springer.

Siciliano, B. 2013. "Foreword." In: Desai, J. P., et al. 2013. *Esperimental Robotics*, Heidelberg: Springer.

Siciliano, B., and Khatib, O. (eds.) 2008. *Springer Handbook of Robotics*. New York: Springer.

Singer, P. W. 2009a. "Robots at War: The New Battlefield," *The Wilson Quarterly,* Winter.

Singer, P. W. 2009b. *Wired for War: The Robotics Revolution and Conflict in the 21st Century.* New York: The Penguin Press.

Sloggett, D. 2014. *Drone Warfare. The Development of Unmanned Aerial Conflict.* Barnsley: Pen & Sword Aviation.

Sloterdijk, P. 2013. "Rules for the human park." In: Idem, *You must change your life.* Cambridge: Polity Press.

Sonnenberg, B. 2014. *Dependencies and Mechanisms of Unemployment and Social Involvement*. Wiesbaden: Springer.

Sparrow, R. 2007. "Killer Robots," *Journal of Applied Philosophy*, Volume 24, Issue February, 62–77.

Stockhammer, E. 2004. *The Rise of Unemployment in Europe. A Keynesian Approach*. Northampton Massachusetts: Edward Elgar Publishing Limited.

Sullins, J. P. 2013. "An Ethical Analysis of the Case for Robotic Weapons Arms Control," in Podins, K., Stinissen, J. and Maybaum M. (eds.). 2013. *5th International Conference on Cyber Conflict*. Tallinn: NATO CCD COE Publications.

Tabarrok, A. 2003, December 31. "Productivity and unemployment," *Marginal Revolution*.

Turse, N. 2012. *The Changing Face of Empire. Special Ops, Drones, Spies, Proxy Fighters, Secret Bases, and Cyber Warfare.* New York: Dispatch Books.

Unece, 2004. "Over 50,000 industrial robots in Italy, up 7% over 2002. Italy is Europe's second and the world's fourth largest user of industrial robots." www.unece.org (accessed April 2, 2015).

Unece, 2005. "Worldwide investment in industrial robots up 17% in 2004. In first half of 2005, orders for robots were up another 13%." www.unece.org (accessed April 2, 2015).

University of Sheffield, 2008, February 28. "Killer Military Robots Pose Latest Threat To Humanity, Robotics Expert Warns," *ScienceDaily*.

Veruggio, G. 2007. "La nascita della roboetica," *Leadership medica,* n. 10. www.leadershipmedica.com (accessed January 1, 2011).

Veruggio, G. 2010, October 26. "Roboetica: una nuova etica per una nuova scienza", *Almanacco della scienza – Micromega*, 7.

Veruggio, G., and Operto F. 2008. "Roboethics: Social and Ethical Implications of Robotics." In: B. Siciliano, and O. Khatib (eds.) 2008. *Springer Handbook of Robotics*. Berlin Heidelberg: Springer, 1499–1524.

Veruggio, G., and Operto, F. 2006. "Roboethics: a Bottom-up Interdisciplinary Discourse in the Field of Applied Ethics in Robotics," *International Review of Information Ethics*, Vol. 6 (12), 2–8.

Vroman, W., and Brusentsev, V. 2005. *Unemployment Compensation Throughout the World. A Comparative Analysis*. Kalamazoo Michigan: W.E. Upjohn Institute for Employment Research.

Wang, L., Tan, K. C., and Chew, C. M. 2006. *Evolutionary Robotics: From Algorithms to Implementations*. Singapore: World Scientific Publishing.

Weber, M. 2008. *Max Weber's Complete Writings on Academic and Political Vocation*. New York: Algora Publishing.

Weinberger, S. 2008, April 15. "Armed Robots Still in Iraq, But Grounded," *Wired*.

Weiner, T. 2005, February 16. "New Model Army Soldier Rolls Closer to Battle," *New York Times*.

Werding, M. (ed.) 2006. *Structural Unemployment in Western Europe. Reasons and Remedies*. Cambridge Massachusetts: The MIT Press.

Whittle, R. 2014. *Predator. The Secret Origins of the Drone Revolution*. New York: Henry Holt and Company.

Winnefeld, J. A. and Kendall, F. 2011, *The Unmanned Systems Integrated Roadmap FY2011–2036*, Department of Defence (USA).

Winnefeld, J. A. and Kendall, F. 2013, *The Unmanned Systems Integrated Roadmap FY2013–2038*, Department of Defence (USA).

Wittes, B. and Blum, G. 2015. *The Future of Violence. Robots and germs, Hackers and Drones*. New York: Basic Books.

Zaloga, S. J. 2008. *Unmanned Aerial Vehicles. Robotic Air Warfare 2017–2007*. Oxford and New York: Osprey Publishing.

Złotowski, J., Weiss, A., and Tscheligi, M. 2011. "Interaction Scenarios for HRI in Public Space." In: Mutlu, B., et al. (eds.) 2011. *Social Robotics*. Heidelberg: Springer.

Znaniecki, F. 1934. *The Method of Sociology*. New York: Rinehart & Company.

Index of names

A
Abney, K. 77, 155
Albus, J. 70–71
Alexander the Great 146
Alexander, J. 21
Amhed, A. 125
Archimedes 146
Aridas, T. 49, 51
Aristotle 55, 77–78, 84, 151
Arkin, R. 79, 92
Asimov, I. 15–16, 32, 80, 83, 86–89, 92, 98, 141, 151, 153–154
Ayres, R. U. 56–57, 151

B
Babbage, C. 37
Bacon, F. 66, 90, 96
Balducci, R. 15, 158
Bartneck, C. 34, 156
Bashir, S. 125, 151
Bekey, G. A. 77, 155
Beltran, C. 27
Bennato, D. 81–82, 101, 104, 107–108, 151
Bergbreiter, S. 30–31 156
Bignami, L. 40, 47–48, 151
Blau, A. W. 28, 157
Blaug, M. 14, 151
Blum, G. 125, 160
Bonaccorso, G. 81–82, 86–87, 151
Boyer, R. 68, 151
Breckman, W. 21
Bremner, P. 34, 154
Brown, A. 127, 137, 141, 151
Brusentsev, V. 15, 159
Bunge, M. 21
Burawoy, M. 21
Bush, G. W. 129, 132

C
Cabibihan, J.-J. 34, 153
Calvino, I. 106, 151
Campanella, T. 97
Čapek, K. 23, 152
Cappella, F. 119, 152
Carr, A. 106, 152
Cartwright, J. E. 110, 152
Chalmers, D. 99
Chew, C. M. 31, 159
Chomsky, N. 125, 152
Christensen, H. 91, 101
Churchill, W. 128
Ciampi, C. A. 79
Clapper, J. R. 110, 152
Clinton, B. 132
Cobb, C. W. 59
Cohen, E. 129
Columbus, C. 98
Comte, A. 11
Conan Doyle, A. 128
Crews, R. D. 125, 151

D
Daerden, F. 30, 152
Dario, P. 79
DeMarse, T. B. 28, 157
Democritus 75
Desai, J. P. 29, 152, 158
Descartes, R. 147
Devereux, T. 129–130, 152
Di Nicola, P. 46, 152
Dick, P. 102
Douglas, P. H. 59

Dresher, M. 135
Dudek, G. 29, 152
Duffy, B. 79

E
Engels, F. 60, 155
Epstein, R. 130
Evangelista, M. 125, 153
Evers, V. 34, 156

F
Feletig, P. 111–113, 115, 153
Finkelstein, R. 121, 144, 146
Fitter, N. P. 77, 153
Flis, M. 21
Flood, M. 135
Floreano, D. 31, 79, 153
Ford, H. 102
Ford, M. 38, 57, 153
Fries, D. 129
Frysztacki, K. 21
Fukuyama, F. 97, 157

G
Galilei, G. 75
Gallino, L. 41, 43–47, 52, 152–153
Ganapati, P. 77, 153
Gangl, M. 15, 153
Ge Shuzhi, S. 34
Geroni, A. 51, 153
Giavazzi, F. 68, 153
Giddens, A. 21
Giugni, M. 15, 153
Gordon, R. 15, 153
Górniak, J. 21
Graeber, D. 72, 154
Grimes, J. G. 110, 152
Groot, L. 15, 154
Gunkel, D. J. 77, 154

H
Habermas, J. 97, 154
Habershon, J. 89, 91, 93, 154
Haddadin, S. 32, 154
Ham, J. 34, 156
Hammond, M. 21
Harnad, S. 99, 154
Harrod, R. F. 60
Hauer, R. 87
Heron 23, 29, 37, 154
Herrmann, G. 34
Hill, J. 110, 157
Horgan, J. 63, 99, 103, 154
Howell, D. R. 15, 154
Hughes, J. 15, 21, 52, 54, 68, 70, 154

I
Inoue, H. 79
Ishiguru, H. 33, 154

J
Johnson, G. 142

K
Kaczynski, T. 64
Kanda, T. 33–34, 154, 156
Kant, I. 132, 136, 137
Kay, E. R. 145, 158
Kendall, F. 113, 116, 160
Keynes, J. M. 14, 68–69, 72, 151, 154, 159
Khatib, O. 29–30, 34, 39, 152–153, 158–159
Koch, C. 99
Korb, L. J. 132–133
Kowalewicz, M. 21
Kramer, S. N. 91, 154
Krugman, P. 57–58, 155
Krzysztofek, K. 21
Kumar, V. 29, 152
Kurfess, T. R. 39, 155
Kurz, H. D. 14, 155

L
Lamm, C. 21
Lee, C. 145, 158
Lefeber, D. 30, 152
Leibniz, G. W. 75
Leigh, D. 145, 158
Lenz, A. 34, 154
Leonardo Da Vinci 29
Leonards, U. 34, 154
Levinson, S. E. 146, 156
Lin, P. 77, 155
Liu, Y. 31, 155
Lowe, A. 14, 155

M
Malinvaud, E. 15, 155
Malthus, T. R. 14
Manzotti, R. 27
Marconi, G. 29
Marshall, G. 11, 155
Martorella, C. 39, 155
Maruccia, A. 126, 155
Marx, K. 14, 48, 55, 58, 60, 71, 78, 155
Mattiussi, C. 31, 153
Mazur, L. 21
McKenna, T. 59
Meggiato, R. 120–121, 155
Menghini, M. 41, 155
Merton, R. K. 21, 59, 142, 155
Messalina 105
Metta, G. 27
Meyrink, G. 108
Mill, J. S. 56, 155
Milne, A. A. 128
Minsky, M. 37, 156
Monopoli, A. 48, 77, 82, 93–96, 98, 104–105, 107, 156
Moore, G. 25, 52
Moravec, H. 25–28, 37, 52, 62–64, 69, 70, 73, 75, 156
Mutlu, B. 34, 156, 160

N
Nadotti, C. 88–89, 156
Narita, T. 30, 158
Nash, J. 135
Natale, L. 27
Nath, V. 146, 156
Nichols, M. 115, 156
Nichols, P. M. 77, 153
Nietzsche, F. 66
Nievo, I. 102, 151
Nobel, A. 79
Noble, D. F. 55–56, 156

O
Olivero, A. 52
Operto, F. 78–80, 82, 156, 159
Ostrup, F. 15, 156

P
Pagano, M. 68, 153
Page, L. 117, 156
Paprotny, I. 30–31, 156
Pareto, V. 136
Pascal, B. 37
Pasquali, V. 49, 151
Pearson, I. 93, 145
Pearson, M. J. 34, 154
Pellicani, L. 21, 67, 156
Petroni, A. M. 148, 157
Pirani, E. 41, 157
Plato 96, 147
Polchi, V. 50–52, 157
Polidori, A. 28, 29, 157
Popper, K. 147
Potter, S. 28, 95, 157
Poundstone, W. 135, 157
Proyas, A. 86
Putnam, H. 99, 157
Pythagoras 147

R
Rampini, F. 95, 157

Ranisch, R. 79, 157
Rao, S. 27
Ray, S. 134
Reagan, R. 132
Relke, D. M. A. 125, 157
Reutter, M. 15, 157
Ricardo, D. 14, 78, 155, 157
Rifkin, J. 56, 157
Riotta, G. 97, 157
Rogers, A. 110, 157
Rubart, J. 15, 157
Russo, L. 23, 67, 157
Russo, M. 41, 157

S
Sacconi, M. 50
Saint-Just, L. A. 105
Salvadori, N. 15, 158
Sanchez, M. 119, 158
Sandini, G. 27–29
Say, J. B. 14
Schor, J. B. 71, 158
Serreli, V. 145, 158
Sharkey, N. 16–17, 125–126, 135, 137, 158
Shin, D. 30, 158
Shoell, H. 140
Shue, H. 125, 153
Siciliano, B. 29–30, 39, 47, 158–159
Simmons, R. 34, 153
Singer, P. 16, 127–130, 132–134, 137, 139, 143–145, 158
Sismondi, J. C. 14
Sloggett, D. 110, 158
Sloterdijk, P. 97, 158
Smelser, N. 21
Smith, W. 86
Solow, R. 59
Sonnenberg, B. 15, 158
Sorgner, S. L. 21, 79, 157
Sparrow, R. 125, 159
Spencer, H. 11
Spiers, A. 34, 154
Sterling, B. 79
Stockhammer, E. 15, 159
Sullins, J. P. 125, 159
Sun, D. 31, 155
Sztompka, P. 21

T
Tabarrok, A. 57, 159
Tagliasco, V. 27
Takanisi, A. 79
Tan, K. C. 31
Tan, Y. K. 34
Tanie, K. 79
Thomas, D. S. 104
Thomas, W. I. 104
Tipler, F. 100, 102–103, 105
Travaglia, M. L. 41, 155
Tscheligi, M. 34, 160
Tucker, A. W. 135
Turing, A. 29, 127
Turse, N. 125, 159

U
Ura, T. 79

V
Verne, J. 128
Veruggio, G. 78–80, 82, 89, 159
Vltchek, A. 125, 152
Vroman, W. 15, 159

W
Wagenaar, D. A. 28, 157
Wang, L. 31, 159
Weber, M. 11–12, 159
Weinberger, S. 118, 159
Weiner, T. 142, 160
Weiss, A. 34, 160
Wells, H. G. 128
Werding, M. 15, 160

Whittle, R. 110, 160
Williams, M.-A. 34
Williams, R. 98
Winnefeld, J. A. 113, 116, 160
Witkowski, L. 21
Wittes, B. 125, 160
Woods, R. 89, 91, 93, 154

Y
Yeh, X. 30, 158
Young, J. J. 110, 152

Z
Zaloga, S. J. 111, 160
Złotowski, J. 34, 160
Znaniecki, F. 11, 160